

3.10 HUMAN HEALTH AND ENVIRONMENT

This section discusses existing background information regarding electric and magnetic field (EMF) effects and corona effects. Because this background information applies to each alternative in the same manner, the discussion is combined rather than repeated separately for each alternative.

Both current and voltage are required to transmit electrical energy over a transmission line. The current, a flow of electrical charge, measured in amperes (A), creates a magnetic field. The voltage, the force or pressure that causes the current to flow, measured in units of volts (V) or thousand volts (kV), creates an electric field. Both fields occur together whenever electricity flows, hence the general practice of considering both as EMF exposure.

The possibility of deleterious health effects from EMF exposure has increased public concern in recent years about living near high-voltage lines. The available data have not revealed any conclusive evidence that EMF exposure from power lines poses a hazard to animal or human health. However, while such a hazard has not been established from the available evidence, the same evidence does not serve as proof of a definite lack of a hazard. In light of the present uncertainty, this section and Appendix B contain a summary of the existing credible scientific evidence relevant to evaluating the potential impacts of EMF, as required by the *National Environmental Policy Act* of 1969 (NEPA) implementing regulations (40 CFR 1502.22).

This section also discusses the safety considerations in the immediate vicinity of transmission lines. Additionally, the potential for corona effects on the human environment from transmission lines is discussed. Corona is the electrical breakdown of air into charged particles caused by the electrical field at the surface of conductors, the wires that carry electricity. Corona effects are of concern for potential radio and television interference, audible noise, and production of visible light.

3.10.1 Electric and Magnetic Fields

Magnetic Field Health Studies. The focus of the EMF health studies for power lines has been on the magnetic fields created by the power lines. Electric fields were studied in previous years, and were not found to be a concern for levels typical of power lines. A 60 Hz magnetic field is created in the space around transmission line conductors by the electric current flowing in the conductors. This is the frequency of ordinary household current, usually referred to as 60 cycle. The strength of the magnetic field produced by an electric transmission line depends on the electrical load, the configuration of the conductors (spacing and orientation), the height of the conductors, the distance from the line, and the proximity of other electrical lines. As the load on a transmission line varies continually on a daily and seasonal basis, the magnetic fields likewise vary throughout the day and year. Physical structures, such as buildings (unless of metal construction), are usually transparent to magnetic fields created by power lines (that is, buildings do not generally have a shielding effect), thus fueling the interest in potential health effects.

Existing EMF levels in the project vicinity are primarily dominated by EMF from common household appliances. EMF levels of some common household appliances are listed in Table 3.10–1. This table shows that the magnetic fields at a distance of 3 ft (1 m) range from less than 0.1 milligauss (mG) to 18 mG. Existing transmission and distribution lines also contribute to EMF levels. Figure 3.11–1 shows existing transmission lines in the project vicinity. As an example of maximum existing EMF, Tucson Electric Power Company (TEP) has modeled existing EMF levels on Bureau of Land Management (BLM) land (reference Figure 1.1–4) from the two existing transmission lines that run adjacent to the north of the proposed project. At a distance of 280 ft (85 m) south of the existing southernmost transmission line (which coincides with the proposed location of TEP's new transmission line), the

existing magnetic field is 1.1 mG and the existing electric field is 0.01 kV/m. At a distance of 340 ft (104 m) south of the existing southernmost transmission line (which coincides with the southern edge of the right-of-way [ROW] of TEP's proposed transmission line), the existing magnetic field is 0.76 mG and the existing electric field is 0.006 kV/m (TEP 2003). The existing EMF level at the southern edge of the proposed ROW is below an average daily exposure to magnetic fields from some common household appliances (approximately 0.8 mG) (NIEHS 1999).

Table 3.10–1. EMF Level of Some Common Household Appliances.

Appliance	Magnetic Field at 3 ft (mG)
Clothes dryers	0.0-1
Clothes washers	0.2-0.48
Electric shavers	Less than 0.1-3.3
Fluorescent desk lamp	0.2-2.1
Hair dryers	Less than 0.1-2.8
Irons	0.1-0.2
Portable heaters	0.1-2.5
Television	Less than 0.1-1.5
Toasters	Less than 0.1-0.11
Vacuum cleaners	1.2-18.0

Source: Waveguide 2003.

No Federal regulations have been established specifying environmental limits on the strengths of fields from power lines. However, the Federal government continues to conduct and encourage research necessary for an appropriate policy on EMF. Several states have opted for design-driven regulations ensuring that fields from new lines are generally similar to those from existing lines. For instance, Florida and New York require ROWs for new power lines 500-kV and higher to be wide enough so that the magnetic field at the edge of the ROW is equivalent to the magnetic field of lower voltage (345-kV) lines. Some states have set specific environmental limits on one or both fields in this regard. Florida and New York limit the magnetic field at the edge of a ROW to 200 mG. These limits are, however, not based on any specific health effects. Most regulatory agencies believe that health-based limits are inappropriate at this time. They also believe that the present knowledge of the issue does not justify any retrofit of existing lines.

Safety. The potential safety considerations in the immediate vicinity of electric power lines include the potential for electric shock, the clearance of the power lines aboveground, low-level military flights in the area, measures to prevent unauthorized climbing of the poles, and the proximity of the transmission lines to other utilities such as the El Paso Natural Gas Company (EPNG) pipeline. The proposed project area includes portions that are part of a Military Operating Area in which the U.S. Air Force conducts periodic low-level flights (see Chapter 10 for the U.S. Department of Energy [DOE] consultation with the U.S. Air Force).

The electric field created by a high-voltage transmission line extends from the energized conductors to other conducting objects such as the ground, towers, vegetation, buildings, vehicles, and persons. Potential field effects can include induced currents, steady-state current shocks, spark discharge shocks, and in some cases field perception and neurobehavioral responses.

- *Induced Currents* – When a conducting object, such as a vehicle or person, is placed in an electric field, currents and voltages are induced. For example, it is not unusual for a fluorescent light tube to glow in the vicinity of high voltage lines. The magnitude of the induced current depends on the

electric-field strength and size and shape of the object. The induced currents and voltages represent a potential source of nuisance shocks near a high-voltage transmission line.

- *Steady-State Current Shock* – Steady-state currents are those that flow continuously after a person contacts an object, such as a vehicle, and provides a path to ground for the induced current. The effects of these shocks range from involuntary movement in a person to direct physiological harm. Steady-state current shocks occur in instances of direct or indirect human contact with an energized transmission line.
- *Spark-Discharge Shocks* – Induced voltages appear on objects such as vehicles when there is an inadequate ground. If the voltage is sufficiently high, a spark-discharge shock will occur as contact is made with the ground. Spark-discharge shocks that create a nuisance occur in instances of carrying or handling conducting objects, such as irrigation pipe, under transmission lines.
- *Field Perception and Neurobehavioral Responses* – When the electric field under a transmission line is sufficiently strong, it can be perceived by hair raising on an upraised hand. This is the effect of harmless levels of static electricity, similar to the effect of rubbing stocking feet on a carpet.

An additional safety concern in the immediate vicinity of electric power lines is the potential for climbing of poles. Poles can be designed in a manner to prevent the unauthorized climbing of the poles by members of the public. In addition, sufficient clearance height must be considered to avoid contact with the lines either directly or by contact with other objects.

The Amended “Certificate of Environmental Compatibility” issued to TEP on October 29, 2001, by the Arizona Corporation Commission (ACC) (ACC 2001), includes a provision that all transmission structures must be at least 100 ft (30 m) away from the edge of the existing EPNG pipeline ROW. TEP would follow this provision in the precise siting of the proposed project.

Smoke is a conductor of electrical current. When a fire is in the vicinity of a 345-kV transmission line, the transmission line could start fires outside the fire perimeter. From 1986 through 1999 there were 67 human-caused fires (burning 13,747 acres [5,563 ha]), and 24 lightning-caused fires (burning 5,692 acres [2,303 ha]) within the Tumacacori Ecosystem Management Area (EMA) of the Coronado National Forest. Of these fires, 53 were less than 10 acres (4 ha), 23 were between 10 and 300 acres (4 and 121 ha), and 5 were over 300 acres (121 ha). The fires were dispersed throughout the EMA, with a higher concentration near high-use areas such as along Ruby Road (USFS 2001).

3.10.2 Corona Effects

Corona is the electrical breakdown of air into charged particles caused by the electrical field at the surface of conductors. Corona is of concern for potential radio and television interference, audible noise (60-cycle hum), and photochemical reactions. Corona can occur on the conductors, insulators, and hardware of an energized high-voltage transmission line. Corona on conductors occurs at locations where the field has been enhanced by protrusions, such as nicks, insects, or drops of water. During fair weather, the number of these sources is small and the corona effect is insignificant. However, during wet weather, the number of these sources increases and corona effects are much greater (DOE 2001a).

The Electric Power Research Institute (EPRI) reports that “corona and arcing activity may occur at numerous points in overhead transmission, substation, and distribution power systems. This activity may result in audio noise or radio interference complaints or indicate a defective component that may be close to failure. If the offending component can be located, it can be replaced. EPRI’s daytime corona and arcing visual inspection technology (DayCor) lets the exact position, type, and magnitude of corona

activity be determined, thus enabling the identification of the offending component and the possibility of failure. DayCor observations are totally unaffected by sunlight and allow corona inspection to become part of everyday inspections” (EPRI 2001).

- *Audible Noise* – Corona-generated audible noise from transmission lines is generally characterized as a cracking/hissing noise. The noise is most noticeable during wet weather conditions. There are no noise codes applicable to transmission lines in Arizona. Audible noise from transmission lines is often lost in the background noise at locations beyond the edge of the ROW. Refer to Section 3.9, Noise, for a complete description of existing noise in proposed project area.
- *Radio and Television Interference* – Corona-generated radio interference is most likely to affect the amplitude modulation (AM) broadcast band (535 to 1,605 kilohertz); frequency modulation (FM) radio is rarely affected. Only AM receivers located very near to transmission lines have the potential to be affected by radio interference. The potential for interference from corona effects is more severe during damp or rainy weather.
- *Visible Light* – Corona may be visible at night as a bluish glow or as bluish plumes. On the transmission lines in the area, the corona levels are so low that the corona on the conductors usually is observable only under the darkest conditions with the aid of binoculars.
- *Photochemical Reactions* – When coronal discharge is present, the air surrounding the conductors is ionized and many chemical reactions take place producing small amounts of ozone and other oxidants. Approximately 90 percent of the oxidants are ozone, while the remaining 10 percent are composed principally of nitrogen oxides. Refer to Section 3.8, Air Quality, for a complete description of existing air quality.